UNIVERSITY OF ALBERTA LIBRARY
0 0001 6719 999

Alberta Dept of Health

ATHABASCA
RIVER OIL SPILL

A.2

TD
427
P4
A86
1970

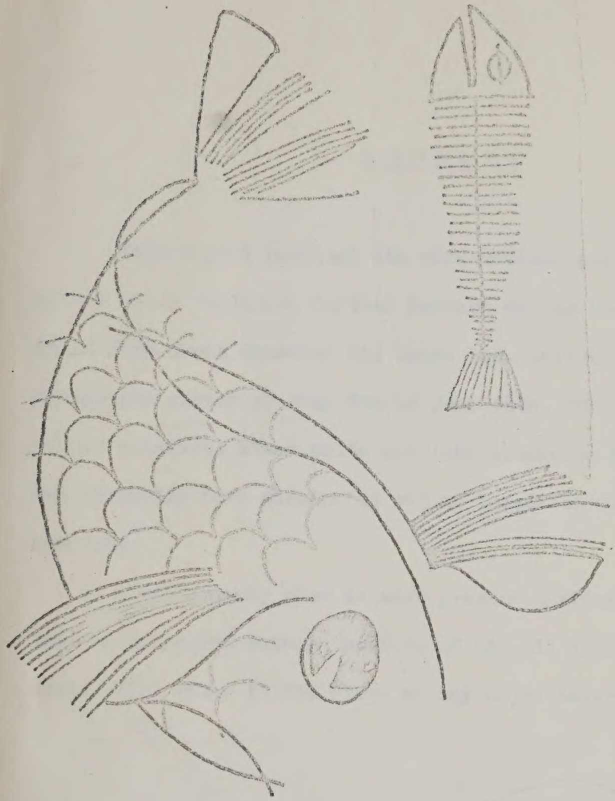
SCI

Ex libris
Universitatis
Albertensis

QUAECUMQUE VERA

~~department of the
environment~~ - library
GOVERNMENT OF ALBERTA

Department of the Environment
Library



UNIVERSITY OF ALBERTA
SEP 2 1980
SCIENCE LIBRARY

ENVIRONMENTAL HEALTH SERVICES DIVISION
GOVERNMENT OF THE PROVINCE OF ALBERTA
DEPARTMENT OF HEALTH

ATHABASCA RIVER OIL SPILL

JUNE 1970

LIBRARY
UNIVERSITY OF ALBERTA

SUMMARY

This report outlines the observations and activities undertaken by the Water Pollution Control Section during the duration of the oil spill from Great Canadian Oil Sands Ltd. into the Athabasca River during the period of June 8th to June 18th, 1970. A further inspection of the Athabasca River Delta and Lake Athabasca indicates that the oil has virtually been dissipated and no immediate problems seem to be apparent.

A contingency plan is also presented which strongly indicates that an agreement between members of the oil industry be undertaken to assist each other in the event of any major hazard to the environment.

E. Kupchanko

E. E. Kupchanko, P. Eng., Head,
Water Pollution Control Section

June 30, 1970

INDEX

Field Investigations 1

Reflections and Comments on the Athabasca Oil Spill with Respect to Future Development 8

Appendix 16

FIELD INVESTIGATIONS

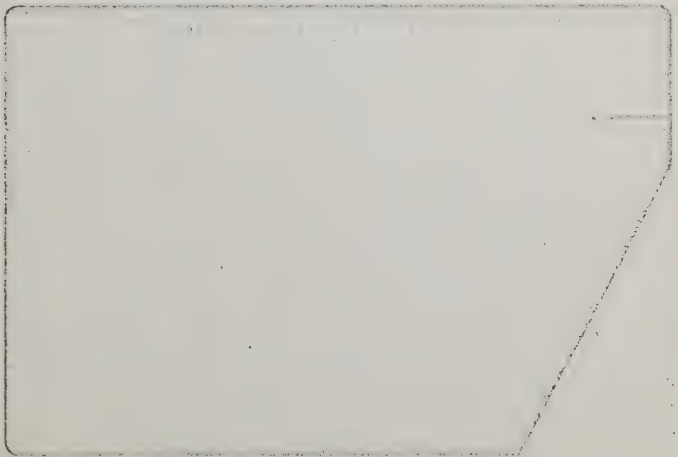
INTRODUCTION

An investigation of an oil spill near the Great Canadian Oil Sands plant at Tar Island was carried out during the period of June 8 - 18, 1970 and on June 25, 1970. The oil spill was due to a 32-inch longitudinal rupture in a 16-inch products line which carries synthetic crude from the plant to Edmonton, Alberta. The location of the break which occurred on the afternoon of June 6, 1970 was approximately one-half mile south of the plant tailings pond and approximately one-half mile from the river. This report summarizes the observations made on the river during this investigation.

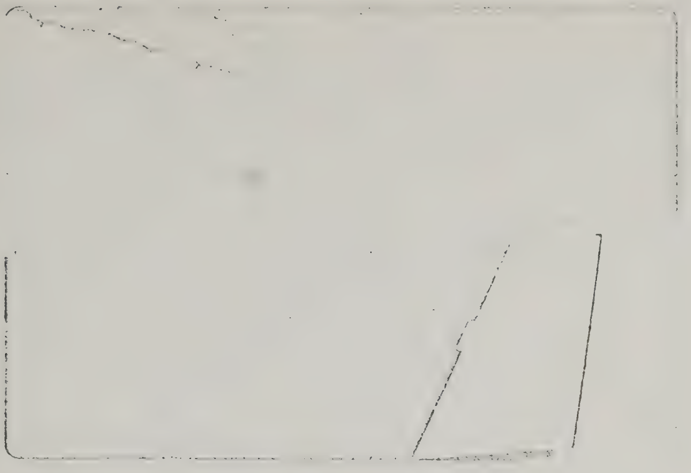
OBSERVATIONS

An aerial survey of the river was made in the afternoon of June 8, 1970 (Figure 1). Between Tar Island and Fort McKay, an oil-water emulsion could be observed in a thin string along the west side of the river with some accumulation of oil in back waters. From Fort McKay to Bitumount, approximately 50 percent of the water surface was covered with an iridescent sheen. A greater quantity of oil-water emulsion could be seen, which varied in width from 10 to 30 feet from the west bank. The area between Bitumount and Embarras showed a dispersion of the iridescent film across the entire width of the water. The emulsion remained along the west bank in a string less than 10 feet wide. The emulsion could not be observed near Embarras. The leading front of the oil film was just downstream from Embarras.

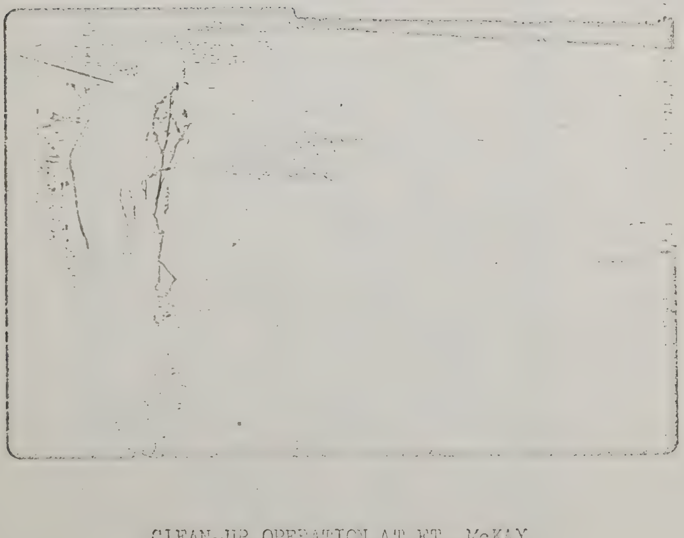
SECTION OF PIPE SHOWING RUPTURE



AERIAL VIEW OF ATHABASCA RIVER SHOWING IRIDESCENT SHEEN

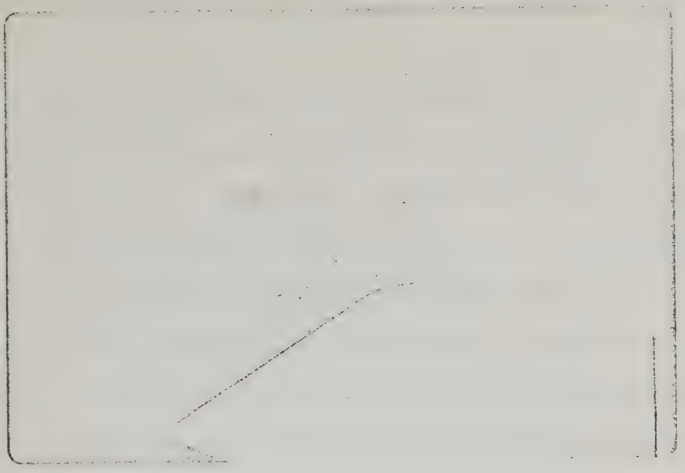


IRIDESCENCE ON THE ATHABASCA RIVER

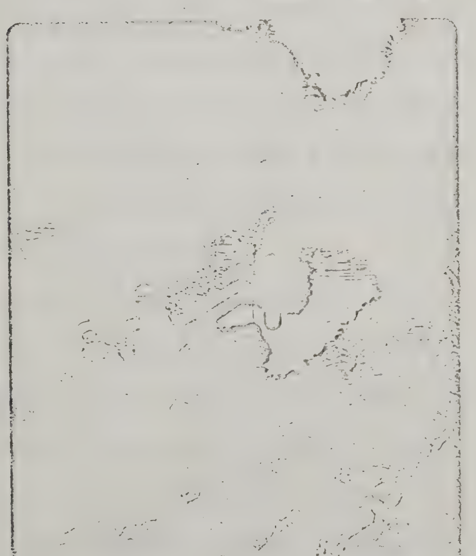


CLEAN-UP OPERATION AT FT. McKAY

DISPERSANT BEING USED ON WEST SHORE



AERIAL VIEW OF PIPELINE RUPTURE AREA



VIEW SHOWING PIPELINE

A ground survey of the river at Fort McKay was made on June 9, 1970. Two crews were engaged in dispersing the emulsion, oil film and and small pockets of accumulated oil along the river bank. The emulsion lay in a very thin broken line along the west bank from which the iridescent sheen spread out for approximately 30 feet.

A program to determine the effectiveness of Corexit 7664 was initiated. An area of the river downstream from Fort McKay was aerial sprayed with this chemical with two loads of 1,800 pounds each, containing 6 percent Corexit 7664. The location where the pipeline rupture occurred was also inspected during the day.

A meeting was held with Mr. A. Boggs of the Fish and Wildlife Division on June 10, 1970. He stated that the oil film could be seen for approximately 100 miles starting from five miles below Fort McKay. He reported sighting oil emulsion extending 10 to 25 feet from the west river bank. He also reported having to kill a beaver which was covered in oil and appeared to be in distress. Mr. Boggs' observations were made from a boat on June 8th and 9th, 1970.

Observations were again conducted from the air in the afternoon of June 10, 1970. During this flight, the iridescent film of oil was seen to be spotty downstream of Fort McKay to a point near Ells River confluence. Here a definite increase in the amount of oil film could be seen with very little evidence of emulsion or oil accumulation. First sign of emulsion was observed five miles downstream of Bitumount. The emulsion along the west bank was in a thin discontinuous string. The opposite bank was clear of emulsion. Near the confluence of the Firebag

River, a continuous sheen was observed throughout the width of the river. Pockets of oil and emulsion could be seen on the east bank. On the west side of the river, emulsion could be seen extending three feet from the bank. The width of the emulsion increased to 30 feet near Embarras, then decreased to a narrow string and completely dissipated near the 27th baseline.

A meeting was held with Great Canadian Oil Sands officials on June 11, 1970 to formulate a method to contain the oil and emulsified oil from reaching Lake Athabasca. It was agreed to remove the emulsified oil from the west bank of the river and remove all free oil accumulation in back waters. Great Canadian Oil Sands stated that all necessary men and equipment would be moved to the Embarras location to stage a two front attack. Two crews would advance downstream from Fort McKay while two other crews would be engaged working upstream from Embarras. To make this operation successful, both chemical and mechanical methods would be used.

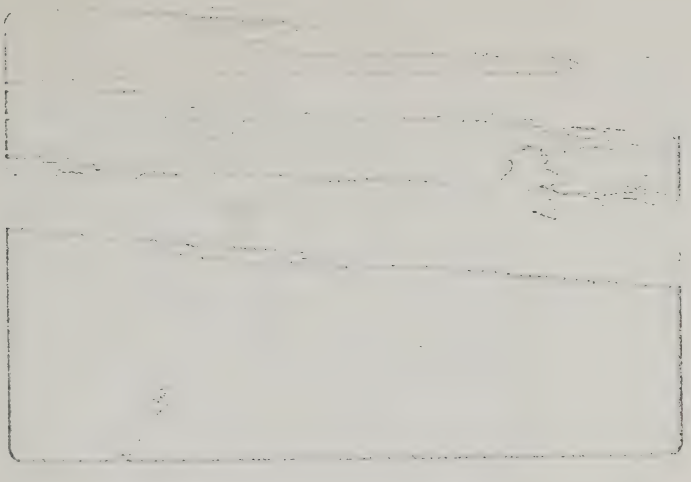
Another air surveillance of the river was made on the morning of June 12, 1970. Near Bitumount, a slight iridescence was observed. Emulsion was not noted until the point near the confluence of the Firebag River was reached. A ground level examination of the emulsion and the iridescent sheen was made near Embarras. The strings of emulsion were one quarter inch in thickness and broke up into globules when scooped up into the hand. The sheen which could be observed from the air was barely visible at water level. The amount of emulsion increased near Embarras Portage extending 20 feet from the north shore. Emulsion was also prevalent on the south

OIL-WATER EMULSION IN ATHABASCA RIVER

AT EMBARRAS - JUNE 16, 1970

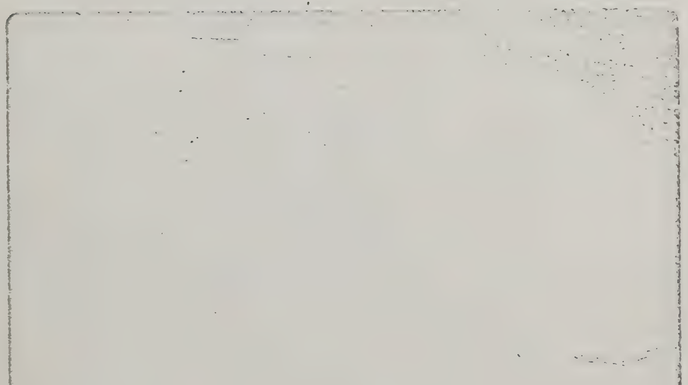
OIL-WATER EMULSION IN BIG POINT CHANNEL

AT BIG POINT - JUNE 16, 1970



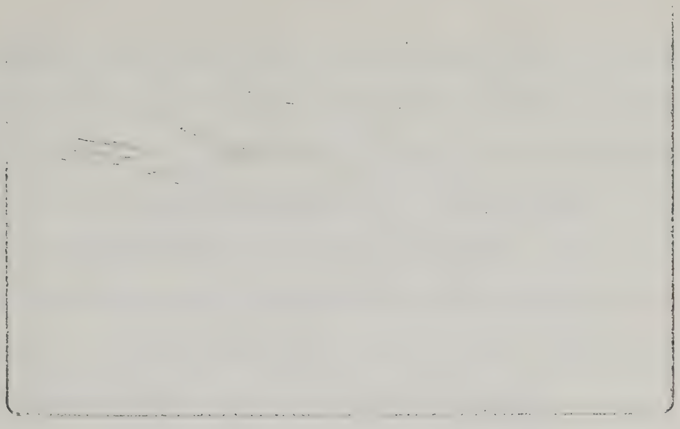
MOUTH OF BIG POINT CHANNEL AT LAKE ATHABASCA

JUNE 16, 1970



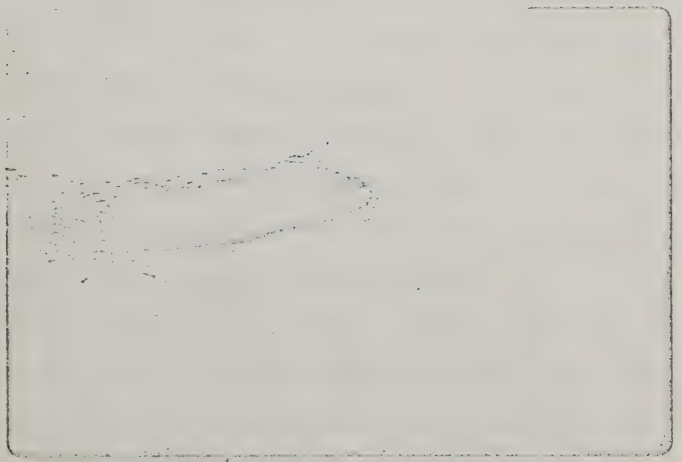
IRIDESCENCE OIL FILM ON DELTA SHORE LINE

JUNE 16, 1970



LAKE ATHABASCA AND DELTA SHORE LINE

JUNE 16, 1970



LAKE ATHABASCA - JUNE 16, 1970

bank with some accumulation of free oil in back waters. Free oil was observed in eddies approximately five miles downstream from Embarras Portage. The largest of the three oil patches was approximately 20 feet by 30 feet and one quarter to one-half inch in thickness. A survey of the main channels in the Delta area was also made. The film of oil had advanced to near the mouth of Fletcher and Big Point Channels but not into the lake itself. During this survey it appeared that the oil would be contained in the main channels of the Delta region.

One June 15th, Mr. Bland of G.C.O.S. stated that he had inspected the Athabasca River by motor boat on June 13th and did not detect any traces of oil or oil-water emulsion as far as 40 miles downstream of Tar Island.

An aerial survey of the Athabasca River between Fort McMurray and Lake Athabasca was conducted during the afternoon of June 16, 1970. First observations of the emulsion in the Athabasca River were sighted just north of the confluence of the Firebag River. From this point northwards to Portage, the emulsion occupied approximately 5% of the water surface coverage and was intermittently scattered along the Athabasca River in twisting formations ranging from 50 to 200 feet in length and varying 10 to 20 feet in width. Free oil was not observed.

In surveying the Embarass River, Fletcher Channel and Big Point Channel in the Delta area, it was noticed that the emulsion strips covered approximately 25% of the water surface. Small patches (20 feet by 2 feet) of iridescent oil film were scattered along the banks of these rivers near their mouths to Lake Athabasca. Very slight iridescence was observed on the calm shore waters of Lake Athabasca in an area north of the Delta and

between the mouths of the Embarras River and Big Point Channel. Iridescence was not evident in the main of Lake Athabasca north of the Delta where windy squalls and wave motions prevailed. A light iridescent film (500 feet by 20 feet) was observed fanning out into the northeast tributary leading to Richardson Lake. However, a surface boom had been installed below the 28th Base Line to contain free oil and the emulsion in Big Point Channel from spreading into Lake Richardson.

In Fort Chipewyan, a meeting was held with Mr. D. Steven of the Canadian Wildlife Services who indicated that:

(1) a boom was being constructed to prevent the flow of oil into Des Rochers River;

(2) application of emulsifiers to Lake Athabasca was discontinued because of potential secondary effects and the oil appeared to have been dispersed by wind action;

(3) biological studies on aquatic life were being initiated to determine long term effects;

(4) a "slick licker" barge was being evaluated to determine its capability in the mop-up operations.

Surface water samples were obtained from the Athabasca River, the Delta channels, and Lake Athabasca by officers of the Department of Lands and Forests on June 8-9, 1970. The concentration of oil and grease ranged from 1.8 mg/l downstream of Tar Island to 12.8 mg/l at Mills Island (Figure 2). No oil was visible in these samples.

River water samples collected between McDermott Island and Chipewyan I.R. contained a 1/8" - 1/2" oil layer on top. Considerable suspended solids were evident in the samples. It is assumed that oil

adhered to this sediment, thus giving high results ranging from 2500 mg/l to 713 mg/l at these respective locations (Figures 3 and 4).

Oil was not present in samples collected from the Athabasca River and Delta channels between Point Brule and Lake Athabasca on June 9, 1970. The concentration of oil and grease ranged from 2.0 mg/l at Point Brule to 0.3 mg/l at Lake Athabasca (Figures 4 and 5).

During the afternoon of June 17, 1970, sub-surface samples were collected with a Kemmerer sampler (Figure 6). The concentration of oil and grease ranged from 0.6 mg/l at Big Eddie Bend in the Fletcher Channel to 0.0 mg/l near Potato Island in Lake Athabasca. Intermittent formations of emulsion were observed in the Delta channels at up to 10% water surface coverage. The emulsion was noticeable at elevated heights but not at ground level.

On June 18, 1970 Mr. A. Galbraith of G.C.O.S. stated that mop-up operations were continuing in the vicinity of the ruptured pipeline. It was anticipated that clean-up operations in the Delta and Lake Athabasca would be completed by the weekend of June 20-21, 1970.

Mr. A. Boggs, Fish and Wildlife Officer, stated that no traces of emulsion or free oil were observed during a motor boat inspection of the Athabasca River from Fort McMurray up to Lake Athabasca at Fort Chipewyan on June 20-21, 1970.

An aerial survey of the Athabasca River, Delta and Lake Athabasca was conducted on June 25, 1970. Emulsion or oil was not evident in these bodies of water. All surface booms (Des Rochers River, Lake Richardson) were removed. A dike of straw bales had been constructed on the west bank of the Athabasca River near the site of the G.C.O.S. ruptured pipe line. This measure would prevent leeching of any residual oil or emulsion

from the immediate area into the river by surface run-off or the fluctuating crest of the river.

Sub-surface water samples of the Athabasca River and Big Point Channel were obtained at Big Eddy and the south end of Tokyo Syne (Figure 7). Oil and grease concentrations were 1.1 mg/l and 0.6 mg/l at these respective locations. These analytical results are considered to be minimal. The aerial inspection of the Delta also indicated that the oil has virtually dissipated and no immediate problems seem to be apparent.

REFLECTIONS AND COMMENTS ON THE ATHABASCA OIL SPILL WITH RESPECT TO FUTURE DEVELOPMENT

PREVENTION PLANS

The primary elements of any oil spillage are essentially -

(1) Prevention of the oil spill

(2) Control or limiting the consequences of the oil spill

(3) Restoration of the shore face and waterfowls

(4) Ecological effects

Pipelines and storage tanks should be designed, constructed, and tested according to established safety codes. Pipelines should be equipped with automatic shut-off valves that stop flow if a break in the pipelines occurs. Most refineries and loading terminals are equipped to handle relatively small spills. It cannot be emphasized too strongly that the best way to handle oil spills is to prevent their occurrence.

SURVEILLANCE AND PREDICTION OF SPILL BEHAVIOR

Aerial reconnaissance of oil spills is far superior to any surface based surveillance system. Large areas can be observed in relatively short periods of time, and the economics gained are significant. Many sophisticated techniques of surveillance are available and include photography, spectrophotometric, infra red, ultraviolet, radar and microwave imaging. It must be remembered that the higher level of sophistication requires skilled personnel for operation and data interpretation.

In general, the capability of oil slick behavior is not too well advanced largely due to the great number of variables involved (all time dependent).

The boundaries of oil spills in rivers and streams can be defined, however the relative emulsification rate cannot be predicted. Similarly, the amount of oil remaining in back waters and on the banks is difficult to predict.

In lakes, slicks will be affected most strongly by wind conditions and can be expected to move at a speed approximately two to four percent of wind velocity.

CHEMICAL TREATMENT

There are a number of compounds and materials available to treat oil slicks. Five classes of collecting agents are generally available for oil slick recovery. These are:

(1) Floating substances such as Peat moss, straw and sawdust. The floating substances are inexpensive and can readily be disposed by burning or burial.

(2) Plastic materials such as polyurethane foam. The use of plastics and other similar materials are rather expensive. Oil can be reclaimed for subsequent use.

(3) Gelling Agents. Gelling agents that solidify petroleum compounds are still in the development stage.

(4) Emulsifiers and dispersants. A large number of dispersants is available, however very little quantitative or comparitative information exists. These materials may be toxic to aquatic life to some degree although several low toxicity dispersants are available. These dispersants break up the oil into particles of one to five micron size and expose a

very large surface area of the oil to natural biological degradation. The low toxicity dispersants available include "Gulf 1009" & "COREXIT 7664" for dispersing crude oil and light fuels and "COREXIT 8666" for heavy fuels. The general conclusion after experience with a number of incidents such as the Torrey Canyon and the Arrow is against the general use of emulsifiers. In general, physical collection is preferred if possible.

(5) Absorbents. Numerous solid absorbents for sinking oil are available. Aquatic organisms may be affected adversely and resurfacing of the oil is possible although delayed in action.

BIOLOGICAL DEGREDATION OF OIL

Biological degredation of hydrocarbons in water is controlled by environmental conditions such as nutrients, temperature, oxygen availability, degree of dispersion of oil in water and micro-organisms present. Under fairly warm conditions, biological degradation can occur in a matter of days. However, this process is greatly decreased under cold weather conditions. Generally, degradation rates appear to be very slow.

PHYSICAL METHODS OF TREATMENT

There are generally three practical physical methods of oil slick recovery all interdependent on each other. These include -

(1) Booming

(2) Burning

(3) Skimming

Booming - Containment of oil spills can be effectively handled by using booms. The ability to confine a spill in the area immediately surrounding the source is principally a function of time, availability of equipment, and prevailing environmental conditions. There are two principal types of mechanical barriers applicable to oil spills: floating booms and underwater bubble barriers. Generally, both methods are suitable only for relatively calm water. The floating boom generally is more portable and involves less erection time. The disadvantage of the bubble barrier is the loss of contaminant in the event of air supply failure.

Different types of floating booms are: wood floats, logs, rubber floats (large diameter neoprene coated), canvas covered cork, chain-weighted boom suitable for permanent installation and plastic type boom. It is extremely important that the boom is readily available for quick placement, is light enough to be handled with limited manpower and can contain the oil in the area used even with strong currents and rough water. The plastic type of boom is probably most suitable because of its ease of storing and handling.

For any oil removal equipment to be effective, it must be modularized and capable of aerial transport and delivery within a short period of time. The equipment must also be compatible. Experience has shown that booms from different manufacturers could not be joined together.

Burning - Burning on the water surface is generally not too effective due to rapid transfer of heat to the water. Burning of oil soaked straw or other materials may be effective. Burning of light fractions such as gasoline may be useful. Burning on the surface water, in lakes and streams is severely hampered by the lack of overall control and of the possibility of forest fires.

Skimming - Mechanical devices for collecting oil from the surface water such as suction pumps, rotating cylinders and belts are available, however the capacity of these units are relatively small. Their use is restricted to relatively calm waters or in areas where the oil layer is quite thick. Overall costs for removing of oil (from harbors) ranges from $1.35 to $3.00 per gallon.

RESTORATION

Physical removal of the contaminated material on the banks of streams and lakes with appropriate earth moving appears to offer the best solution. Addition of absorbing material such as straw, sawdust or clay can assist pickup. Plowing under is unsatisfactory because the water may ultimately cause resurfacing of the oil.

Detergent cleaning has been used in combination with mechanical filling.

It appears that physical removal with the assistance of absorbents as necessary and possibly backed up by limited use of detergents is the best method of restoration.

BIOLOGICAL AND ECOLOGICAL EFFECTS

Attempts to clean large numbers of oiled birds and animals are futile. Of the many thousands of oiled birds captured and treated following the Torrey Canyon incident, a small percentage recovered. Small concentrations of petroleum products and derivatives are toxic to aquatic organisms. Due to the diluting effects of the water, the concentrations that would be directly lethal to the aquatic organisms may not always be reached. There may be a number of subtile effects,

however, that may escape the casual observer. These subtile changes may be more prominent during certain periods of the animals' life stages or when environmental conditions are marginal for survival. Tainting of aquatic organims especially fish may result. Such indirect effects warrant more detailed study before any catergorical statement can be made on the overall effect of aquatic organisms.

Oil pollution generally changes the species composition of bacteria present in the water so that forms utilizing petroleum as an energy source temporarily predominate.

Many detergents and demulsifiers are toxic to bacteria, protozoa and other microscopic organisms in the food chain. In some cases, their toxicity exceeds that of oil alone.

BIOLOGICAL AND CHEMICAL EVALUATION

Both the Fish and Wildlife Division of the Department of Lands and Forests and the Environmental Health Division share a mutual concern for surface water quality and the potential hazard of pollutants affecting the ecological balance of the natural environment. The Fish and Wildlife Division represents expertise in several phases of freshwater and wildlife ecology, physiology, and toxicology. The assessment of the environmental requirements for aquatic life and wildlife and the determination of environmental concentrations of potential toxicants that are not harmful under long-term exposure are areas that are investigated by the Environmental Health Division. Surveillance of an oil spill incident involves prediction of the behaviour of the spill and evaluation of the effectiveness of the clean-up operations. The immediate short-term effects of an accidental

oil spill on water fowl, fish, beaver, etc. can be objectively evaluated. For example, oil can cause tainting of fish or edible invertebrates. Oil sludge deposits on the shores or bottom of the receiving body of water may become effective toxicants to sensitive benthic organisms. Depending on the extent and magnitude of the oil spill, the ecological deviation may or may not be immediately apparent. However, stabilization of the ecological balance in the contaminated body of water will occur after sufficient time has elapsed to allow biological activity to recover to normal. The chemical analyses of water samples performed by the Environmental Health Division and the biological data and long-term studies of aquatic life and fauna by the Fish and Wildlife Division serve to complement one another. A policy of strong liaison between the two departments exists to this extent and this greatly assists in providing a basis for comprehensive evaluation of any water pollution problem.

CONTINGENCY PLANNING

Contingency planning for coping with major oil and hazardous chemical spills should be undertaken with a systematic approach. Planning should be focused on specific geographical locations in relation to river basins and navigable lakes. The contingency planning should be directed specifically at -

(1) Providing an estimate of accident probability including severity location and path of pollutant.

(2) Reviewing sectors of the economy and resources that might be affected and how these might dictate or restrict control methods.

(3) Establish where necessary a warning and communication network to be activated in the event of an emergency including an inventory of equipment and supplies and their sources, and sources of real-time environmental data that may be required in the event of an emergency.

(4) Provide for a rational basis for stockpiling control of restoration equipment and materials (and by what agency).

(5) Establishing specific plans of action for selected situations of higher estimated probability and severity.

(6) Identifying significant control measures that must be taken in advance.

It is recommended that an agreement between members of the oil industry in Alberta be made that in the event of a fire, spill release or other emergency which endangers the environment, the companies will assist each other by providing the available materials, equipment and manpower to deal with the situation.

Any party to this agreement responsible for the occurrence will be responsible and pay for the cost of equipment and material provided by the other parties used in combatting the emergency. If the responsibility for the emergency cannot be ascertained, then each of the parties will share the cost of the equipment.

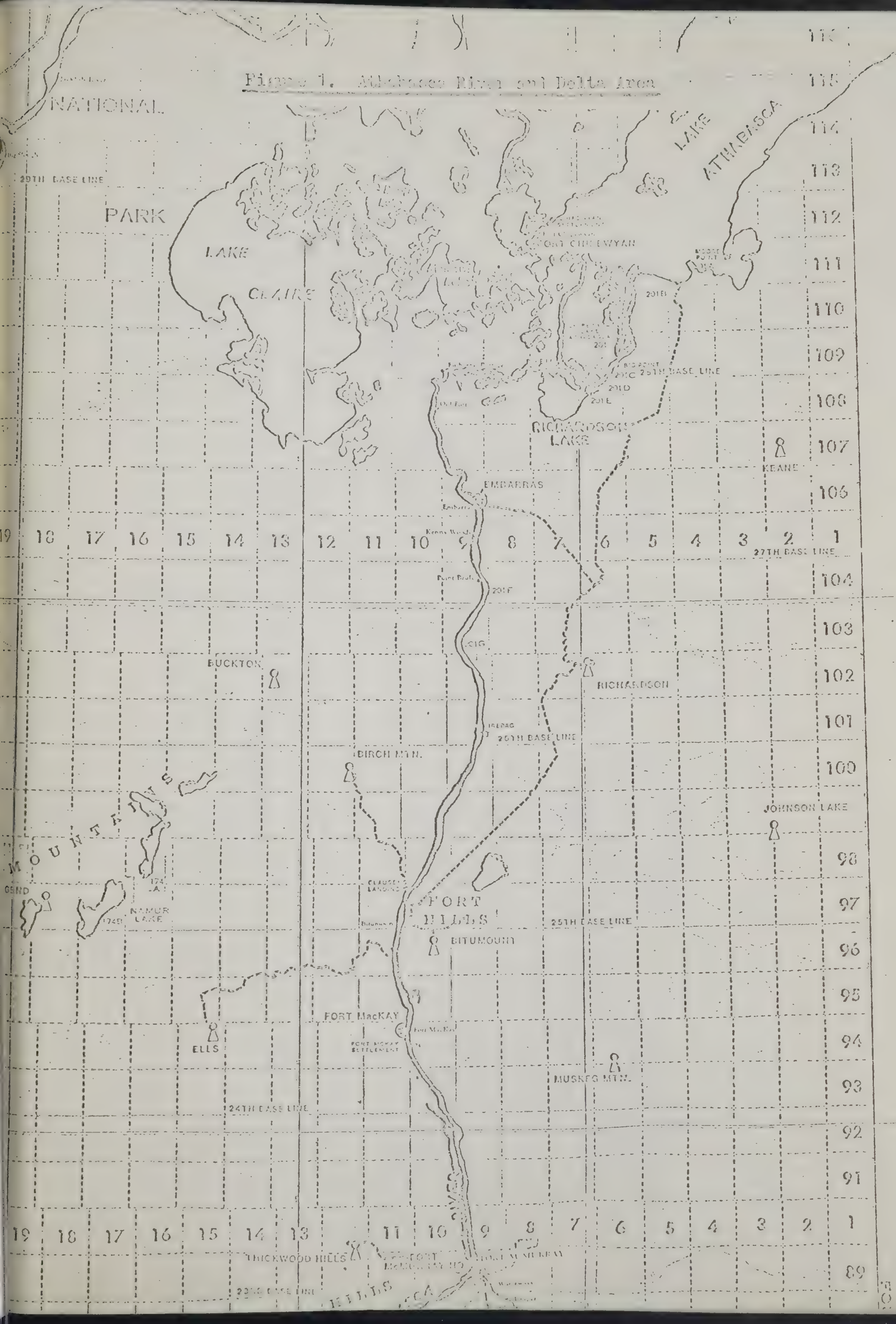
A Masuda.

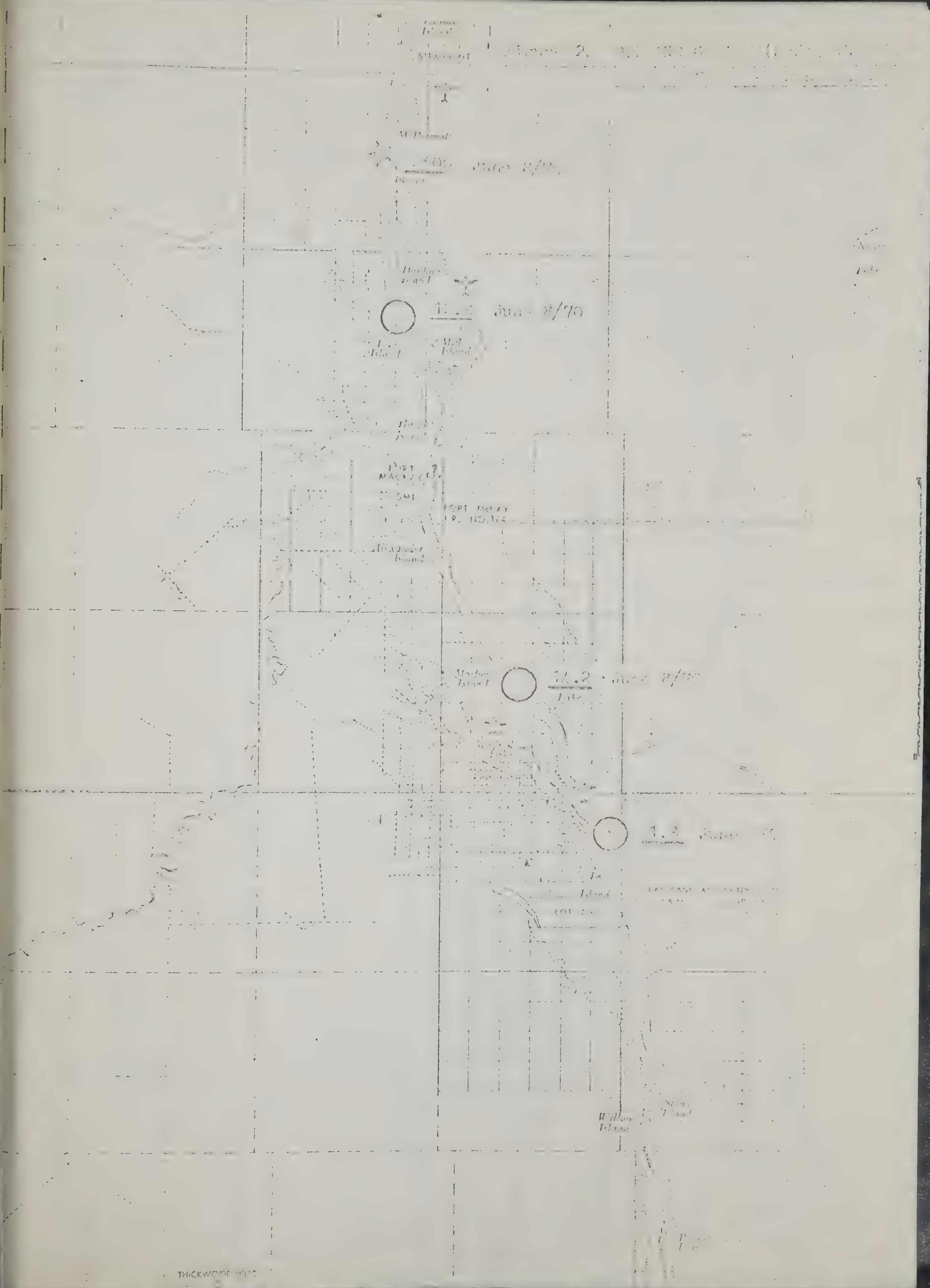
A. Masuda, P. Eng.
P. Shewchuk, P. Eng.
Water Pollution Control Section

APPENDIX

FIELD SURVEILLANCE OF ATHABASCA RIVER
AND DELTA AREA

Figure 1. Athabasca River and Delta Area



FORT MACKAY
FORT McKAY I.R. NO.174
Alexander Island
8/70
8/70
Lake
Island
Willow Island
THICKWOOD HILLS

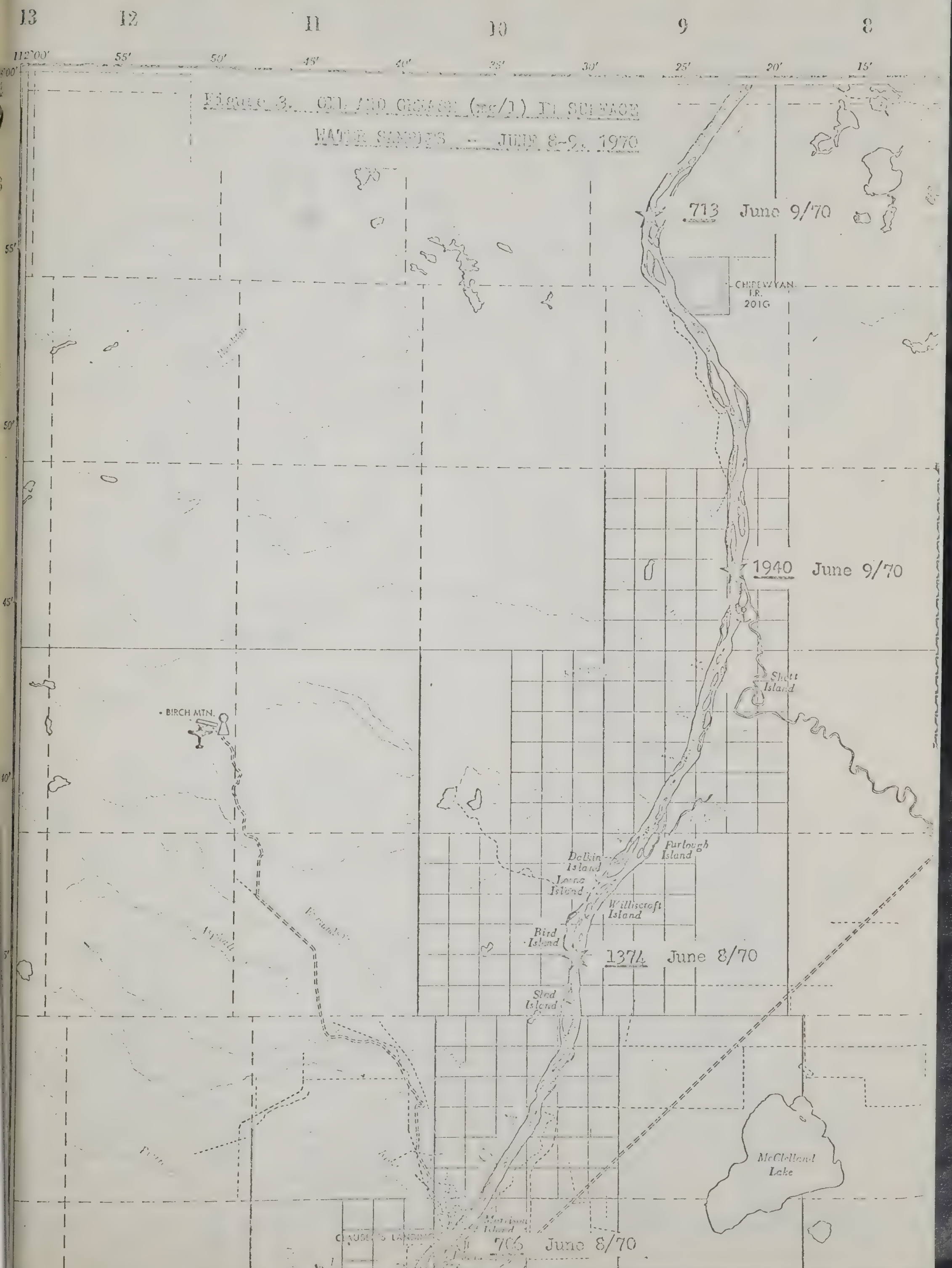


Figure 3. OIL AND GREASE (mg/l) IN SURFACE WATER SAMPLES - JUNE 8-9, 1970

Figure 4. OIL AND GREASE (mg/L) IN SURFACE WATER SAMPLES - JUNE 9, 1970

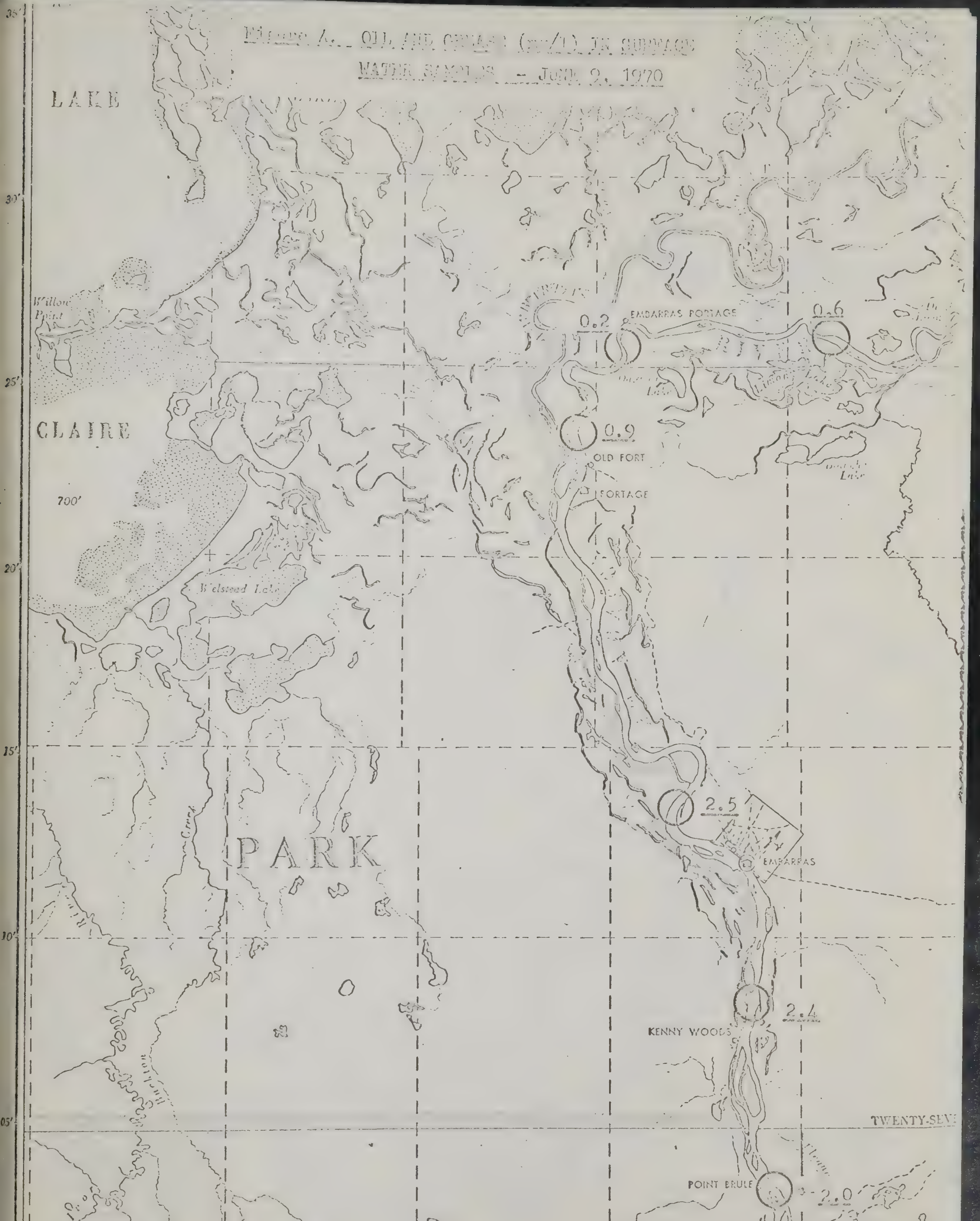


Figure 5. OIL AND GREASE (mg/L) IN SURFACE WATER SAMPLES -- JUNE 9, 1979

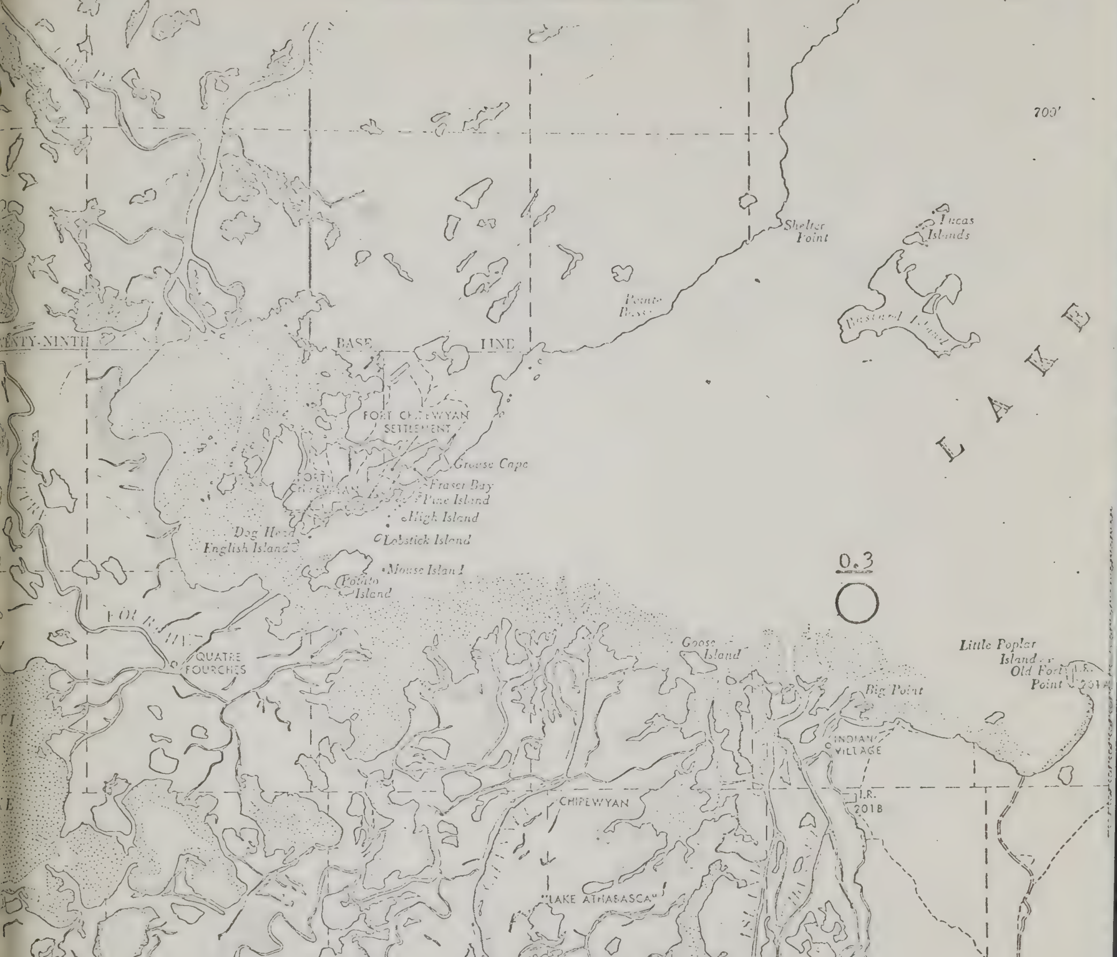


Figure 6. [illegible] (µg/l) [illegible]

[illegible] Samples

[illegible] 1989

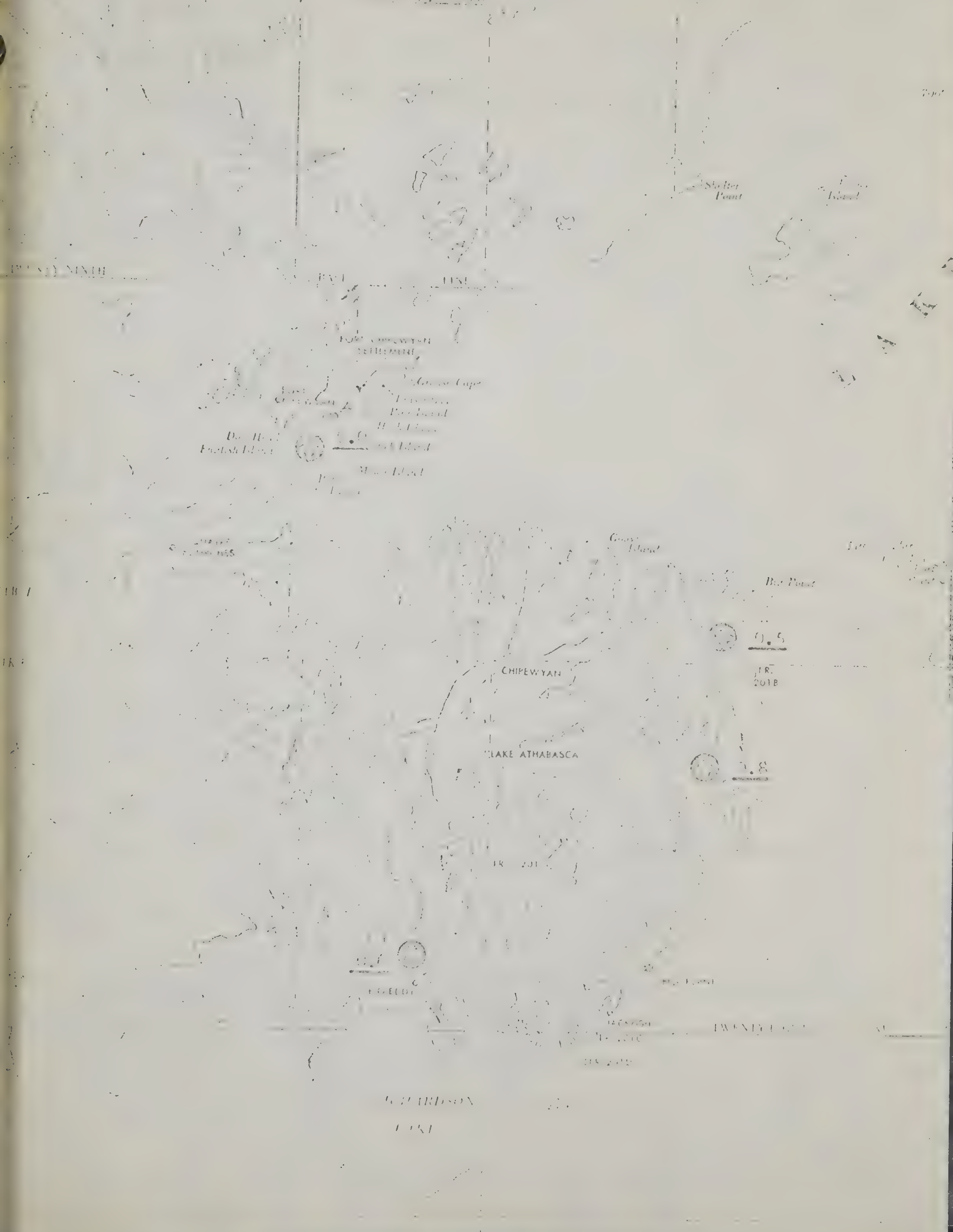
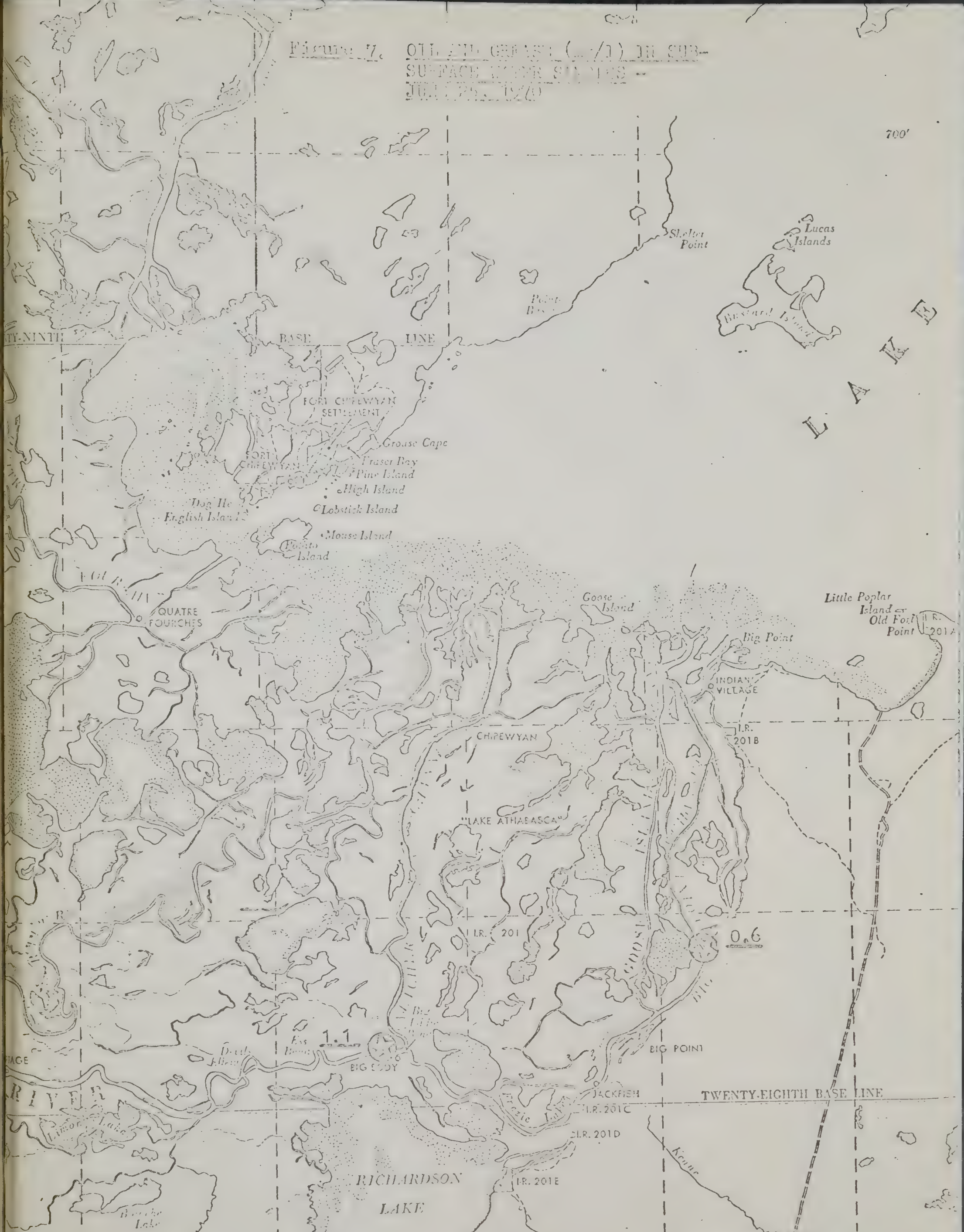


Figure 7. OIL AND GREASE (mg/l) IN SUB-SURFACE WATER SAMPLES - JULY 25, 1970



TD 427 P4 A86 1970
ATHABASCA RIVER OIL SPILL JUNE
1970 --

39799061 SCI

000016719999

Department of the Environment
Library

TD 427 P4 A86 1970
Athabasca River oil spill,
June 1970. -

39799061 SCI